LESSON WOLF TRAP

About This Lesson

Students will perform a simple experiment to test for the presence of microbial life in soil. The test is similar to experiments done by NASA scientist Wolf Vishniak in Antarctic terrain analogous to Mars. Students will look for the development of increasing turbidity in samples of nutrient solution inoculated with either Earth soil or Mars soil simulant.

Objectives

Students will

- Conduct a controlled experiment.
- Make detailed observations of the experiment.
- Measure any observable changes in the variable.
- Form conclusions based upon their observations during the course of the experiment.

Background

During the planning for the Viking Mars probe missions, scientists proposed many different experiments for the probe to conduct. One scientist, Wolf Vishniak, proposed a very simple experiment that would, in his opinion, definitely determine if the Martian soil contained any living microorganisms. Although the experiment, which later became known as the Wolf Trap, was not chosen for the mission, it still remains as an excellent test of whether or not a soil sample contains living organisms.

Vocabulary List

opaque, translucent, transparent, turbidity

Materials

- 500 ml beakers or approximately 1 liter jars with lids (1 per group)
- plastic bowls or dessert plates (for lids if beakers are used) – 1 per group
- stirring rod (or tall spoon) - 1 per group
- distilled water (6 liters)
- bouillon cubes (4)
- sugar (113 Grams) ¼ of a cup
- hot plate
- Dutch oven, or other large soup pot
- Penlight (1 per group)
- 4 X 6 unlined white cards (1 per group)
- eyedroppers or pipettes (1 per group)
- Metric rulers or measuring (1 per group)
- Fresh soil samples (10g / group of one soil only)
- Optional: Mars soil simulant (10g / group of one soil only)
- Balance
- Hand lens (if microscope is not available)

- Slide and cover slip (if microscope is used) – 1 per group
- Lab sheets and pencils (1 per student)
- Beakers (two) for disinfecting soil
- Plastic wrap to cover beakers
- Alcohol in spray bottle (no more than 50 ml)
- Timer (or clock with second hand)
- Beaker with clear water for reference

Procedure

Advanced Preparation **This mixture should make enough nutrient broth for 9 lab groups.*

1. Empty distilled water into clean pot.
2. Add bouillon cubes and sugar to water.
3. Heat solution until all of the cubes and sugar have dissolved, stirring occasionally to insure that all is well mixed.
4. Bring solution to a boil and maintain for 5 minutes.
5. Carefully pour 500 ml into each beaker (or jar) and cover with lid. DO NOT screw lid down if jars are used.
6. Allow liquids to cool.
7. Disinfect control soil sample -- Take 10 grams of each soil and place in separate beakers, mist with enough alcohol to wet soil thoroughly. Cover beakers with plastic wrap and leave undisturbed for 24 hours prior to lab.

Classroom Procedure

1. Divide the class into groups of 3 – 4 students.
2. Pass out Student Sheets and review entire procedure with students.
   (Students could be asked to develop their own procedure if there is time.)
3. Make sure that one group within each class uses the disinfected soil. Do not notify students that there is a sterilized soil or do not tell them which soil was sterilized.
4. Discuss team results and the implications for using this technique on Mars.

Extension

Use JSC-Mars 1 (Mars soil simulant) for ½ of beakers. It may be ordered from:

Office of the Curator
NASA Johnson Space Center ST
Houston, TX 77058

STUDENT PROCEDURE SHEET
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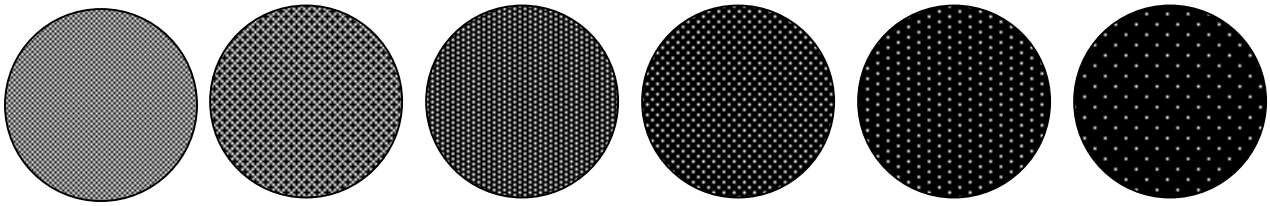
1. Discuss the preparation of the nutrient liquid in the beaker.
2. Invent a group name and use it to label the beaker (jar).
3. Choose one type of soil for the group.
4. Using balances, measure 10 grams of soil.
5. Fill a beaker with clear water and place it in a room that can be darkened.
6. Add soil sample to the broth and stir the mixture gently for exactly 1 minute.
7. In a darkened room, place the beaker on a table and shine the light from a penlight through the side of the container (and the solution) onto the white card held on the opposite side of the beaker/jar. The light should TOUCH the container side and be exactly 10 cm above the tabletop; the card should be held vertically 3 centimeters from the container and touch the tabletop.
8. Use the beaker with clear water as a reference point to observe a completely transparent medium.
9. Decide how turbid the broth is. Use the Scale of Increasing Turbidity to help calibrate your observations. Let one + represent completely transparent and 10 +'s represent opaque. Write notes on the data chart.
10. Record data on Wolf Trap Student Sheet (at START).
11. Prepare a wet mount slide with solution taken from the beaker, using 1 drop and a cover slip.
12. Observe slide under microscope, starting on the lowest power and progressing to high power.
13. On the Student Sheet, in the circle for the first day, draw what you observed on the slide.
14. Cover the beaker with a loose covering of foil or plastic film.
15. Allow the cultures to sit undisturbed for 24 hours at room temperature.
16. On the second day, in a darkened room, again shine a penlight through the solution, determining turbidity level.
17. Record results.
18. Repeat steps 7 – 14 every day for 5 days.
19. Answer questions on student sheet and discuss answers with the class.

Scale of Increasing Turbidity (1 is low turbidity -- 6 is high turbidity.)



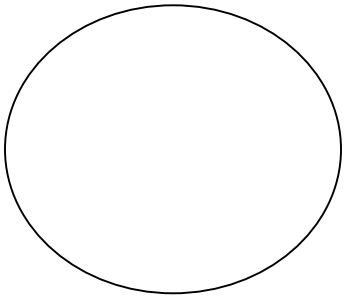
1 2 3 4 5 6

WOLF TRAP

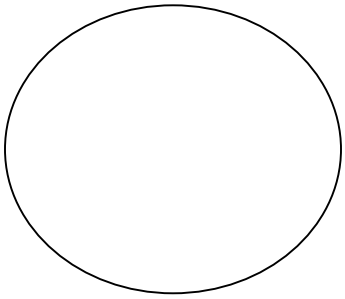
DAY **TURBIDITY LEVEL Data Chart**

Start	
Day 1	
Day 2	
Day 3	
Day 4	
Day 5	

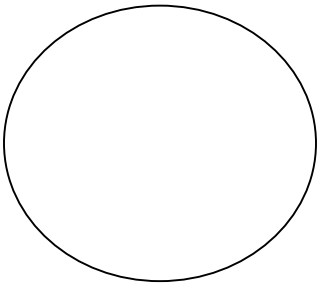
Microscopic Results



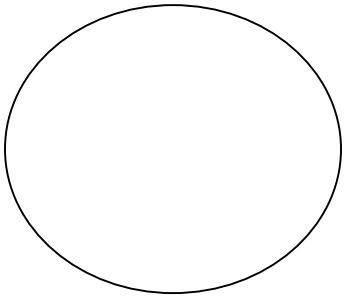
Start



Day



Day 2



Day 3

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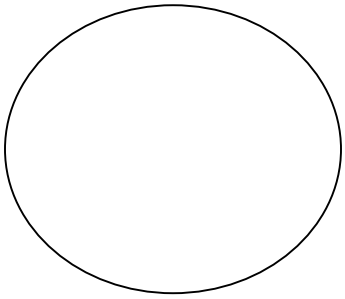
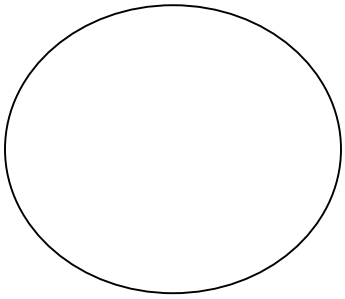


Day 4



Day 5

Observations

1. Was there a noticeable change in the cloudiness of the solution from day to day? If so, describe those changes.

2. Did you observe objects under the microscope? Did any of them appear to be alive?

3. If you saw objects under the microscope, did you observe any changes in them from day to day? If so, in what way did the number or appearance of them change as time passed?

Conclusion:

Based upon your data and observations, would you say that the soil sample contained living organisms? What other factors might have influenced your experiment? Justify your answer.